Industrial structure, business demography and innovation

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Abstract

The analysis addresses path dependency by studying development in industrial structure in Norway over time, and relates types of changes in firms to innovation activities in the firms as identified by the Norwegian innovation survey. A typology of changes is developed on the basis of matched employer-employee data allowing differentiating between events like entry and exit, take overs and spin-outs. Results show that despite a large degree of underlying turbulence the underlying industrial structure remains relatively stable over time - although with the well known reduction in primary industries and growth in service industries. Changes are more pronounced in terms of employment than in terms of value added which show a stable or increasing trend in virtually all industries. Combining with innovation data reveals that types of changes in firms vary with innovation modes. In particular, strategic innovators are found less frequently among unchanged organisations than is the case for other types of innovators. On the other hand a higher share of subsequent transformed establishments is found among strategic innovators.

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Introduction

The purpose of the current paper is to present an empirically based overview over the composition of the Norwegian industrial structure, and to highlight some of the changes that contribute to dynamics. Firstly, information on numbers of firms and employees are used to describe the development over time. Industrial structure in the form of degree of continuity in the composition of firms and industries is used as a rough proxy for path dependency. If the structure to a large extent is reproduced over time the argument is that changes in firm behaviour and entry of new firms takes place within activities where the existing competences can be applied. If existing activities are reduced and new ones increase over time it is considered to represent a reorientation of the prevailing path of industrial development. The observed patterns as identified here are discussed against the three layers of path creation discussed in Wicken (2007); local small scale, centralised large scale and science-based industries. To cover a relatively long period of time the distribution of employment over the period 1949 to 2006 is used to indicate the dynamics of the composition of activities. For the period from 1970 onwards value added is included in order to highlight the relationship between labour input as the structural indicator and the varying productivity between sectors resulting in a different assessment of the dynamics.

Secondly, the paper addresses the types of changes in firms that contribute to changes – or reproduction – of the prevailing structure. The assumption is that improvements in industrial performance takes place both in the form of innovation activities in existing firms and in the form of changes in the composition of firms in the economy by entry, exits and different forms of takeovers and reorganisations. The two processes are expected to be related so that innovation activities affect how firms are organised and reorganised and the incentives and opportunities for entry and exit of firms. On the other hand, reorganisations of existing firms

and actual and potential entry and exit are expected to affect incentives to innovate in existing firms. This is mainly due to changes in the competitive environment as a result of a new composition of firms with changed opportunities and challenges. Thus, the incentives to innovate may become reduced or increased depending on the circumstances. An econometric study of some of these issues is included in Clausen et al. (2007).

Innovation activity is observed for the year 2001 with reference to innovations introduced over the period 1999 to 2001. The data source is the Norwegian CIS 3 survey. The taxonomy of types of changes is based on the more limited periods from 1988 to 1994 and 1995 to 2001 due to availability and quality of data. Also changes occurring after the observed innovation activity are used covering business demographic changes over the years 2002-2005.

In previous contributions not much is found studying both innovation activity as recorded by CIS type survey data and business demographic changes. Most studies are occupied with innovation or demographic changes, and not the combination of the two. An exception is the paper by Clausen et al (2007), combining industry dynamics and innovation activity at the industry level. Another exception is Baldwin and Johnson (1999) who find successful and high-growth entrant firms to be more involved with innovation than other firms in Canada. This work is, however, limited to small firms and focuses on entrepreneurial entry only. Another example is Jensen et al (2006) studying firm survival dependent on innovative investments, finding that successful innovation causes survival, but that survival of young entrants is higher in the context of innovative and uncertain contexts, whereas incumbent firms are more successful in less innovative industries. The indicators for innovative investments are patenting and trade marks, respectively representing high and low risk forms of innovation. We are able to distinguish a range of different types of business demographic

changes, not only restricted to single- or multiplant firms or business births versus expansions (Armington and Acs, 2004, Tveterås and Eide 2000 for Norwegian data). The methodology can also be applied across all sectors, including services and across all firms with employment.

In what follows development over time in industrial structure is presented and discussed in part 2. Part 3 introduces business demography, the methodology used and the results. In part 4 innovation activity is introduced as the last type of change generating processes and combined with the business demography information. Conclusions are found in part 5. Additional tables are collected in a separate appendix.

Norwegian industrial structure 1949-2006

To get an overview over the development in industrial structure in Norway over most of the post-war period, the number of employees by industry is used. One should be aware that there is an element of forcing stability onto the structure as a result of sticking to a classification system over time, since new industries and activities have no historical categories. Examples of this problem include emerging industries like ICT or biotechnology. We nevertheless think such overview give important information about the Norwegian economy.

[CHART 1 ABOUT HERE]

Starting off with the earliest period in chart 1 we see a relatively stable pattern over time, although there are some distinct changes in particular industries (see also appendix table A 1). Most evidently we see the well known decline in the share of employment in primary industries, in particular agriculture and hunting being reduced from around 25 % in 1949 to

around 12 % in 1969. This development continues in the next period from 1970 to 2006 (appendix table A 2) when the share of agriculture, hunting and forestry is down to 2,6 %. On the other hand we see a very stable share of employment within manufacturing around 23 % all the way up to 1970. What that means is that several service industries absorb the free labour resources from the primary industries, to a large extent quite evenly distributed between the industries. A major leap is seen, however, for trade up to around 1970 after which the share stabilises around 15 %. Business services also show a remarkable upturn from just over 1 % in 1949 to more than 10 % in 2006, with a particularly high growth in the latter part of the period. The well known expansion of public employment is also visible, although not in public administration and defence as one might think, but rather in health and social work that in the Norwegian context to a large extent are organised as part of public sector. The same holds true for education though growth is less pronounced for this sector than for health and social work.

Within manufacturing there are some fluctuations in the relative positions of the industries, but a major impression from the first period is one of relatively stable patterns. Exceptions include textiles, wood and wood product both declining in size whereas machinery and other equipment expands the employment. From 1970 onwards we see a more dramatic change for manufacturing, reducing its share of employment from around 23 % in 1970 to around 11 % in 2006. The major reduction starts from around 1980 and a level comparable to 2006 is reached by 1992. Even though the rate of decline is unevenly distributed between manufacturing industries, the decline is present in all sectors at the level of aggregation presented here. Over the same period primary industries keeps on contracting, and the freed up labour resources all go to the expanding service industries, in particular business services

and health and social work – the latter making up close to 20 % of employment in 2006. The development in different industries between 1970 and 2006 is illustrated in chart 2.

[CHART 2 ABOUT HERE]

The last part of the period coincides with the expansion of the oil sector, but its direct contribution to employment is rather marginal. This is different when we bring value added into the picture. Starting in the mid 70s it grows steadily to account for some 8 % of value added in 1988 and as much as 28 % in 2006. In other industries there is a closer relationship between the share of employment and the contribution to value added. Value added in 1970 and 2006 by industry is reproduced in chart 3 where the huge contribution of the oil and gas sector is evident.

[CHART 3 ABOUT HERE]

Having so far focused on the share of employment and value added in different industries, the picture looks different when studying the development in the *level* of value added (at fixed prices) in each industry. We see the significant growth in business services, but other industries also increase production (charts 4 and 5).[1] This applies even to agriculture, hunting and forestry (from 13 billions in 1970 to 17,5 billions in 2006) and manufacturing (from 112 billions in 1970 to 161 billions in 2006). With just a few exceptions we find growth or more or less stable levels in all industries. The development is thus representing a general and significant increase in productivity in the vast majority of industries (see chart 6 and table A 4 in appendix). This may be seen as an illustration of Wicken's point (Wicken 2007) that new activities – or paths – do not necessarily replace existing activities. Rather they seem to

coexist to a large extent, as far as it comes to the level of production. In terms of employment the situation is different as employment in many industries is reduced. What seems to happen then is that production for most industries seems to be continued in parallel with the introduction of new activities, but this happens by means of increased productivity freeing up labour for the new activities. As pointed out by Wicken, other changes may also occur that are not visible at the level of aggregation used here, for instance the shift in much of Norwegian shipyards from producing boats to producing oil rigs and related equipment.

[CHART 4 ABOUT HERE]

[CHART 5 ABOUT HERE]

Another way of putting it can be that most activities – at this level of aggregation and in terms of value added - are carried on over time, thus representing path dependency. The concrete activities within these broad categories may change, and the productivity within each sector increases over time thus representing a different production technology. But a certain degree of persistence over time in terms of presence in certain industries seems to be the case. The increase in productivity frees up resources that are used for expansion in certain industries, and this expansion is not equally distributed between the industries. Over time this contributes to the change in relative industrial structure that we observe and to the over all increase in productivity.

[CHART 6 ABOUT HERE]

Seeing the increase in productivity one might suspect that one reason for this is related to economies of scale, or a tendency for incumbent firms to monopolise their markets. This does not seem to be the case. Average sizes of the establishments vary between industries, but are relatively stable over time – although with a downward tendency for many industries (table A 5 in appendix). This is partly due to the fact that the information is at the establishment – or plant – level. The sizes of enterprises, which in many cases contain several establishments, may grow independent of change in average establishment scale. At the establishment level we are not observing particularly high levels of industry concentration, as measured by a Herfindahl index based on shares of employees in the industries that is used (table A 6). The tendency over time is rather in the direction of less concentration than the opposite. Again this may be different at the enterprise level or by using other measures such as turnover.

Next we turn to the processes affecting the compositions of firms in industries in terms of business demography, before addressing renewal of the incumbent firms in terms of innovation activity.

Business demographic changes

Entry by new firms may contribute to changing the industrial structure, but only as far as the new firms survive and grow, and as long as they appear in other industries than the existing ones. Their development interacts with the operations of the existing and sometimes reorganised firms to determine the net effect for industrial structure, employment and value added. In this section we take a closer look at the types of reorganisations taking place.

To construct a classification of structural changes we have used matched employer-employee register data. The material covers enterprises and establishments with employment, and all

employees, over the time period (1988– 2005). For both the employer and employee sides, basic information is available, like industry, size, and localisation. On this basis establishments and enterprises are classified according to type of change, such as spin-outs, takeovers, Greenfield births, closures, unchanged, and so on (Nås et al 2003). Only performance measures of a basic type are found within the registers, such as survival and number of employees. This can, if desirable, be augmented in follow up work by for instance education and value added.

The basic step in classifying the different kinds of changes in the population of enterprises and establishments involves utilising their formal identification numbers.[2] Changes in identification numbers between subsequent years are being used to identify the interesting classes of changes. Looking at the enterprise level first, there are only three options; each firm remains unchanged, we observe a new firm, or we observe a firm that has disappeared. Bringing in establishments allow further detailing as establishments can change even if the enterprise retains an unchanged ID number. Establishments can also remain unchanged, be new or close down. In addition they can be transferred between enterprises. On the basis of this information it is possible to distinguish 9 different events. An overview of the categories used in the present context is found in box 1.

[BOX 1 ABOUT HERE]

Some of the other information that is utilised in this study is collected at the enterprise level, in particular innovation activity. It is a choice to make whether the analysis should be carried out for establishments or for enterprises. Even though the classification here is presented at the level of establishments, it is possible to map the changes from the establishment level to enterprises by assigning an event to the enterprise if it has affected one or more of the

establishments that belong to it, even though the occurrence of several events in the same enterprise cause some problems. The other option is to keep the establishment as the unit for analysis, and adapt information about innovation activity to the establishment level as discussed below. At the enterprise level we can distinguish between single establishment and multi establishment enterprises, as is frequently done in the literature (Armington and Acs, 2004, Tveterås and Eide 2000). However, the information on types of changes becomes less detailed, and it has been decided to use establishments as the unit of analysis for the rest of the paper. To some extent this is modified by weighting with the numbers of employees which then becomes the unit in focus.

Ideally the analysis should cover a relatively long period of time as in the previous section, since business demographic changes and innovation activity takes time to develop and create economic results and effects. However, reasonably good data are available for the years 1988 onwards. Also, in 1995, a break in the series occurred so that the analysis have to be split into two parts; the period 1988-1994, and the period 1995 to 2001.[3] For the former period, information on innovation activity cannot be matched at the firm level. Also from 2001 to 2002 there is a break in the series, making it difficult to do time series analysis across this point in time. Here the problem is solved by adding a separate analysis covering the period 2002-2005, for which the information is internally consistent. It also fits well with the timing of the innovation data so that the period 1995-2001 covers changes prior to the observed innovation activity, and the period 2002-2005 covers changes after observed innovation.

Included in the analysis are establishments with employment. Within the industries covered, a total of around 100 000 establishments are included in the analysis for the years 1988 and 1994, whereas some 140 000 (1995) and 150 000 (2001) are covered for the later years. Due

to a less restrictive definition of being employed from 2002 onwards, the numbers of establishments for the years 2002-2005 increases to some 260 000 and 280 000 respectively. In terms of employment some 1,4 million employees are included for 1988 raising to 1,9 million employees in 2001. The increase in numbers of observations is partly due to changes in the register system in 1995, and partly due to expansion of the public sector, health and education. Also the latter is to some extent due to a better coverage and classification of this sector in the registers, but reflects a real growth in public sector activity over the period as discussed above. For 2002 and 2005 the employment tolls up to around 2,2 millions.

[CHART 7 ABOUT HERE]

Looking at the types of changes that occur over 6-year periods like we do here, we find that unchanged establishments make up around 45 % for the 1988-1994 period, decreasing to just over 40 % for the 1995-2001 period (see chart 7 and table A 7). The level of turbulence seems to be growing over time, and the share of stable establishments is down towards 30 percent in 2002-05 (recalculated to correct for the shorter observation period). The length of the observation period is essential as the share of stable firms when comparing two consecutive years typically is around 85-90 percent – as is found also for the other Nordic countries (table 1 below). The largest category of change is entrepreneurial new establishments (34%-40 %) and complete closures (30% and 37%), both of them increasing over time. The other categories of change represent a smaller number of establishments but still cover a significant number of cases. This applies to spin-outs that represent some 1700 cases in the first period and close to 3200 in the second period, and new by expansion with 8500 cases in the first period and 7000 in the second – and still higher in the 2002-2005 case after correction for the period. Partial closures also contributes to the turnover with some 10 500 closures in the first

period and 7300 in the second. All together this indicates a significant turnover in the population of establishments over the 6-year periods we consider here – with turbulence increasing over time. The development is broadly speaking in line with what we have found also for the other Nordic countries.

Bringing employment into the picture reveals what shares of employment that are affected by the different types of the business demographic changes (table A 8). Still the larger single category is the unchanged establishments with more or less the same share of employment as of share of establishments (just over 40 %). We see, however, that the shares affected by closures, and the shares working in entrepreneurial new are significantly lower, as both new entrants and closures are on average smaller than other establishments. These categories nevertheless cover a significant number of employees, as some 460 000 are found in totally new firms in 2001, having been established since 1995. Similarly, some 310 000 employees worked in firms that are totally closed down by 2001, and additional 100 000 in establishments that represent partial closures. Looking at changes in existing establishments, such as transformations, takeovers and spin-outs, they are on average larger than cases of closures and entrepreneurial new establishments and contribute more in terms of employment than in terms of number of establishments. Around a fifth, or some 400 000 employees, are found in establishments in 2001 that has undergone some transformation since 1995. In addition comes some 55 000 affected by takeovers and some 10 000 in establishments moved from one enterprise to another.

For the last period from 2002 to 2005 we only cover 3 years. If we expect changes to be relatively evenly distributed over time the shares of establishments being changed should be somewhere around half of what we found for the previous 6 year periods. Looking at table 12

we clearly see a higher share of unchanged establishments compared to the previous periods, which is in line with the expectations. Correcting for the length of the observation period as in chart 7, there nevertheless seems to be more turbulence in the latter period that in the earlier ones. We also see a share of closures and new firm creation at the same level as for the longer periods that becomes large taking observation length into account. This is probably in part due to a higher degree of changes taking place after the population of enterprises has been expanded in 2002 by some 100 000 very small units. We also see for this time period a much lower share of transformations taking place. This is also a result of the increased sample, as transformations mainly take place in bigger enterprises. In terms of numbers of occurrences the level is more in line with the expectations. In sum, turbulence appears to be increasing, but this is most probably an artifact of greater coverage of very small establishments.

The presence of the different types of changes in the organisations varies between industries. For example, the majority of entrepreneurial new establishments occur within different service industries, both in terms of numbers of establishments and numbers of employees. On the other hand, services also dominate in terms of closures, signifying a higher degree of turnover of firms within services than in manufacturing industries. A detailed representation of the distribution of all the change categories between industries is found in table A10.

This is also illustrated in chart 8 showing shares of new establishments and closed establishments over the 1995-2001 period. It is evident that both the level of turbulence and the net effect in terms of growth or decline in numbers of establishments vary significantly by industries. Such changes both contribute to the redistribution of activities between industries, but also to renewal within the industries. The last point is not visible, however, as we only include information for the starting point and ending point of a process that is basically

continuous. The general picture is one of net growth in numbers of establishments and numbers of employees in most services industries, and of decline in manufacturing. Only for postal services and telecom we see a decline in number of employees among the service industries. There are, however, many exceptions to this general picture, and for many industries the development in numbers of establishments and numbers of employees differs markedly. As an example, the number of establishments within basic metals shows an increase of 22 % but a decline in employment of 2 %. For metal products the number of establishments increases by 3,5 % whereas employment goes up 13 %. The exact reasons for this sharp increase in average establishment size are not investigated further. Industries also differ in the sense that some have high rates of both entry and exit, but with a more or less balanced level leaving the number of establishments more or less unchanged; in other industries the level of change is not necessarily as high, but there is a significant difference in entry and exits. Examples of first type include hotels and restaurants and oil and gas extraction, whereas the latter include computer and business services with a growing number of establishments, and postal service and telecom, and agriculture, as examples of contracting industries in terms of numbers of units.

[CHART 8 ABOUT HERE]

An important question to understand the development is whether the Norwegian situation is different from what we find in other countries. Comparable data are scarce, but a similar analysis for four of the Nordic countries was carried out for the period 1999-2000 (Nås et al, 2003). The results revealed some differences in the industrial distributions of changes, but at the aggregate level the relative contributions from the different types of changes were very similar across the countries (table 1 below), including growth in public sector employment.

One should note, however, that the taxonomy of changes in public sector activities depend on bureaucratic regulations and reorganisations that are not fully comparable to changes in private firms.

[TABLE 1 ABOUT HERE]

In a quite recent Eurostat report, business demography in Europe is also addressed (European Commission 2004). The report presents data on birth and survival rates for enterprises across European industries. Although there are challenges when it comes to comparability, the report shows some interesting patterns. In brief, most countries show the same basic pattern of growth in services and decline in manufacturing. The Norwegian case is not very different; however, birth rates in services tend to be among the higher in the comparisons. The report does not go into detail about other types of changes as discussed here.

Innovation and technological regime

In this section the intention is to introduce technological regimes as a factor shaping the industrial structure. We then need some indicator(s) for the underlying knowledge conditions of the firm or industry (Nelson and Winter 1982). Most studies have difficulties obtaining good indicators for technological regimes. (Audretsch 1997) distinguishes entrepreneurial versus routinised regimes based on over/under representation of counts of number of innovations in a firm compared to the industry average. The option chosen here is to utilise innovation survey data. The data contains a rich array of information about the enterprises' innovation activities allowing us to define and distinguish different regimes.

Innovation means the introduction of something new to the firm that have the potential to affect its market position, by introducing changes to the products or mix of products, or changes in the means of production and distribution and their costs. As a consequence, the relationships between firms are changed, thus affecting their relative sizes and profitability. We expect reorganisation of firms to be related to the types of innovation, for instance how radical the innovations are. Changes in structure may apply to the innovators themselves or to other firms in the industry that experience changing competitive environments

A limitation with innovation data is that they are survey based and so far collected every fourth year. Therefore the information on innovation brings a static element into an analysis that is basically dynamic in terms of changes in populations of enterprises over time. Innovation data for 2001 is used. Since the CIS survey that is used covers a selection of industries and only enterprises with 20 employees or more, and is a sample for firms with 10 to 49 employees, the survey's coverage is far less complete than is true of the registers used for the demographic categories discussed earlier. The coverage of number of employees is, however, far better than the coverage of number of firms due to the large firm bias. In the present analysis only enterprises that are covered in CIS are included when the data sources are combined.

Even if the innovation data distinguish among many types of activities and results, a simple product-process innovation breakdown is often used. Alternatively a series of different innovation activities and characteristics are entered into the analysis, often at the cost of complicating. An option used in Clausen et al (2007) is to apply factor analysis to a series of innovation (and business demography) variables at the industry level in order to identify clusters with distinct characteristics. Here the grouping is done the other way around; existing

variables are interpreted and grouped into different "innovation modes" at the enterprise level. This results in a measure of innovativeness that is relatively simple to handle, and somewhat more nuanced than the product-process dichotomy. It may, however, be open to question exactly how the different categories should be interpreted and understood. We use here a categorisation of firms into four types of innovators in addition to those recorded as non-innovators.[4] The four categories consist of combinations of variables with the intention to distinguish the most creative innovators from those relying on copying and combining knowledge from external sources. The categories are presented in some detail in box 2 below. They are labelled:

1. Strategic (creative) innovators
2. Intermittent(second-stream) innovators
3. Technology modifiers
4. Technology adopters

One can always discuss the quality and relevance of innovation indicators obtained by this kind of surveys, and whether or not they are meaningfully related to technological regimes. There are many problematic issues related to their interpretation, such as how the different indicators or variables are defined, communicated and understood, whether they can meaningfully be compared across firms and industries, and how they relate to economic theory and other measures of inputs and outputs. In the present context this discussion is not pursued, and it is accepted that the innovation data actually do measure meaningful aspects of innovation activities of firms, but without putting much emphasis on what the differences signifies.

Combining innovation data with business demographic changes creates challenges when it comes to the unit of analysis. The demographic categories are defined on the basis of establishments, whereas the innovation survey is carried out at the level of enterprises. This is handled in the current context by assuming that innovation activity in enterprises can be made available to all establishments belonging to it if it is considered relevant. This may of course be considered a very big assumption, especially when enterprise boundaries span multiple industries. On the other hand it may be equally problematic to assume that establishments in multi establishment enterprises have no access to the common knowledge pool. In practise the relevant level of analysis will vary from case to case which would require information about the cases that is not presently available. Therefore innovative characteristics of enterprises are used for all establishments belonging to them as a pragmatic solution to the problem. The unit of analysis consequently becomes establishments, sometimes weighted by numbers of employees. Since the occurrences of innovations are more frequent among large enterprises than small ones, and since the large ones also have more establishments associated on average, this creates a large firm bias in the analysis. On the other hand, the mere occurrence of innovation at the outset gives small firms the same weight as a larger one, which is clearly a small firm bias. It is particularly wrong if one is interested in for instance how large share of employment that is affected by innovation. We therefore consider the present approach to be a reasonable first approach to tackle the problem, with the above remarks in mind.

[BOX 2 ABOUT HERE]

The resulting distributions between innovation modes for Norway and EU are illustrated in chart 8 below, using the original enterprise level data scaled to population totals. Even if the overall share of innovators does not differ, there is a clear difference in the profile of

innovators. In particular the share of strategic innovators in Norway is low compared to EU, offset by a higher share of modifiers. Adopters and intermittent innovators are equally represented in EU and Norway.

[CHART 9 ABOUT HERE]

The distribution of innovation modes of Norwegian industries, including the non-innovators, is found in table A 11. We see that as many as 68 percent of the enterprises in the population are classified as non-innovators. Innovation modes differ significantly between industries. As an example, strategic innovators make up a larger share of firms in electrical and electronic manufacturing (around 25 Percent) and in pulp and paper and chemicals (17 percent), than in other industries. The higher share of adopters is found within financial services (18 percent) where the share of strategic innovators is less than 1 percent.

In the following only the unweighted innovation sample itself will be used since the information is matched to the demographic data. As large firms are fully covered in the sample they make up a larger part of the analysis than if we correct for the sample bias by adding weight to the smaller firms. Consequently the numbers of innovators turns out somewhat higher as bigger shares of large firms are innovators than among smaller firms. The difference of about 10 percentage points adds more or less equally to the four innovation modes, but somewhat less to adopters than to the other categories. This is because the share of adopters is somewhat lower among larger firms than for the full sample.

[CHART 10 ABOUT HERE]

Combining innovation modes and business demographic information results in a change in the unit of analysis from enterprise to establishment, as discussed above. The resulting distributions show more or less the same relative distribution between the innovation modes, but with an even lower share of non-innovators (48 percent) due to the large firm bias (chart 10). 10 percent of the establishments are classified to the group strategic innovators, 15 percent as intermittent innovators, 18 percent as technology modifiers, and 9 percent as technology adopters.

There seems to be interesting differences in the types of organisational changes that have taken place in the period prior to the observed innovation activity for innovators of different types (table 2). For instance the shares of non-innovators vary from 33 percent among establishments where a move has taken place and 38 percent for new by expansion establishments, to 65 percent for spin-outs. This may be difficult to understand at first sight, but one should be aware of the difference to spin-off firms. These are often portrayed in other discussions as highly innovative. Spin-offs are in the present context treated as establishment of new enterprises where employees have brought an idea with them that they believe in. Spin-outs, on the other hand, are whole establishments that are moved out of an existing enterprise to form a new separate enterprise. These cases are almost by definition single establishment units. In many cases they represent activity outside of the core business of the mother enterprise and therefore outsourced – possibly as an alternative to closing it fully down. If this is the case it can help explaining the high share of non-innovators. Further investigations are needed to decide on this matter. In cases of takeovers, even if they are few, none of them are recorded as innovators in the subsequent period. Only 7 percent of establishments where the organisation is unchanged are found to be strategic innovators, whereas 25 percent of the cases where a partial closure has taken place are recorded as

strategic innovators. Also cases where transformations have taken place seem to be overrepresented as strategic innovators, with a relatively low share of non-innovators. This indicates that there are differences between the groups of firms introduced that can be investigated in more detail.

One should take into account that the differences probably are related to the sizes of enterprises and establishments. As an example, the occurrence of any kind of reorganisation is more likely in large organisations than in smaller ones. There are also industry differences, partly as a result of varying size distributions, but also as a result of differences in technological opportunities.

[TABLE 2 ABOUT HERE]

Turning the causal direction the other way round we would also expect innovation activity to affect the types of changes that occur in the subsequent period. In table 3 below innovation modes are combined with the demographic change categories for the years 2002-2005. One should keep in mind that the observation period in this case is shorter so that the observed numbers of cases with change is expected to be about half of what holds true for the 1995-2001 period. There are nevertheless not very big differences in subsequent presence of different types of changes between the innovation modes. We find somewhat higher shares of establishments experiencing transformations within the strategic group which is generally experiencing the lowest share of establishments with no change. They also seem to have slightly more spin-outs on the one hand, and more partial closures on the other. Intermittent innovators also come out with a relatively large share of establishments that are taken over by

other firms. New by expansion seems to be relatively more frequent between adopters and non-innovators.

[TABLE 3 ABOUT HERE]

Conclusions

The analyses show a relatively stable composition of industries over time, but with changes in the direction of expanding services sectors and contracting manufacturing. In terms of production (value added at fixed prices) there is an increase or at least stability over the long period from 1949 to 2006 with few exceptions. Employment on the other hand is shifting more, uncovering big changes in the underlying productivity that varies between industries. This general picture indicates that renewal and reorganisation of production to a certain degree seems to build on the existing activities and competences, thus supporting a hypothesis of path dependency. In particular the evidence seems to be in line with a hypothesis as the one put forth in Wicken (2007), allowing old paths and activities to coexist rather than being replaced when new activities are introduced.

There are, however, differences within the broad industry classes. Under the surface of a certain degree of stability or slow change there are a lot of reorganisations going on in the existing enterprises and establishments. It is possible by means of matched employer-employee data to differentiate types of organisational change over time that can be used to study the interrelationship with innovative activities in enterprises and establishments. Around 60 percent of number of establishments in 2001 has undergone some kind of change since 1995, a share that is about the same when taking employment into account. The degree of turbulence seems to increase over time. The major part of changes is in the form of entrepreneurial new establishments and complete closures. A comparison with other Nordic

countries reveals the same basic pattern between the countries, as does less detailed classifications in different EU countries.

Innovation activities are classified into four different modes, where the Norwegian case reveals less strategic innovation and more modifying innovation activity than is found for the EU as a whole. Innovation is also studied at the level of establishments which show the same basic pattern as for enterprises, although with a large enterprise bias. Intermittent innovators and technology modifiers make up the larger shares of innovators, whereas strategic innovators make up some 10 percent of the establishments. The types of innovators seem to vary with the type of organisational change, and in particular the strategic innovators are less frequently associated with unchanged organisations than the other innovation types. We expect the relationship to be influenced both by size and industry affiliation of the firms. Tracking changes in firms in the shorter 3 year period following the observed innovation activity show less obvious relations. We find somewhat higher shares of establishments having experienced transformations within the strategic group. They also seem to have slightly more spin-outs on the one hand, but also more partial closures. Intermittent innovators come out with a relatively large share of establishments that are taken over by other firms. The analysis has shown that it is worth while to follow up on the analysis to better describe and identify the systematic and significant correlations between organisational changes and innovation activity – with causality going in both directions.

Notes

[1] Please note that oil and gas extraction is not included in chart 4 since value added was 0 in 1970 (the base year for the index).

[2] An enterprise is the smallest combination of legal units that is an organisational unit producing goods or services, which benefits from a certain degree of autonomy in decision-making, especially for the allocation of its current resources. An enterprise carries out one or more activities at one or more localities. An enterprise may be a sole legal unit. It may consist of one or many establishments. An establishment is an enterprise or part of an enterprise that is situated in a single location and in which only a single (non-ancillary) productive activity is carried out or in which the principal productive activity accounts for most of the value added. Sometimes the terms "firm" or "company" are used when the distinction is not of any importance – "firm may therefore refer to either an establishment or an enterprise. By an employee is meant a person that is employed to work at least 10 hours per week for an identified employer (establishment and enterprise) at the time of observation for the period 1988-2001.

[3] Two different changes occurred in the data base in 1995. Firstly, the system for identifying the units was changed so that it is not possible to track single units through 1995. Secondly, the industry code was changed from ISIC rev2 to NACE, without proper backward compatibility. The latter problem is overcome by recoding older observations on the basis of ISIC codes and NACE classification in later years, but at the cost of introducing less detailed breakdowns and creating more stability than would otherwise have been. To deal with the break in ID numbers the analyses is separated into two 6 year periods; 1988-1994, and 1995 to 2001. Merging in information on innovation activity is not possible for the former period of data. Lastly, a change in the definition of being employed was introduced in 2002 in such a way that it is not possible to reconstruct the previous definition. Therefore the analysis can presently not be extended beyond 2001 without major reservations. However, the period from 2002 onwards is internally consistent.

[4] The classification is developed by Anthony Arundel and Paul Crowley in connection with the OECD Trend Chart analysis.

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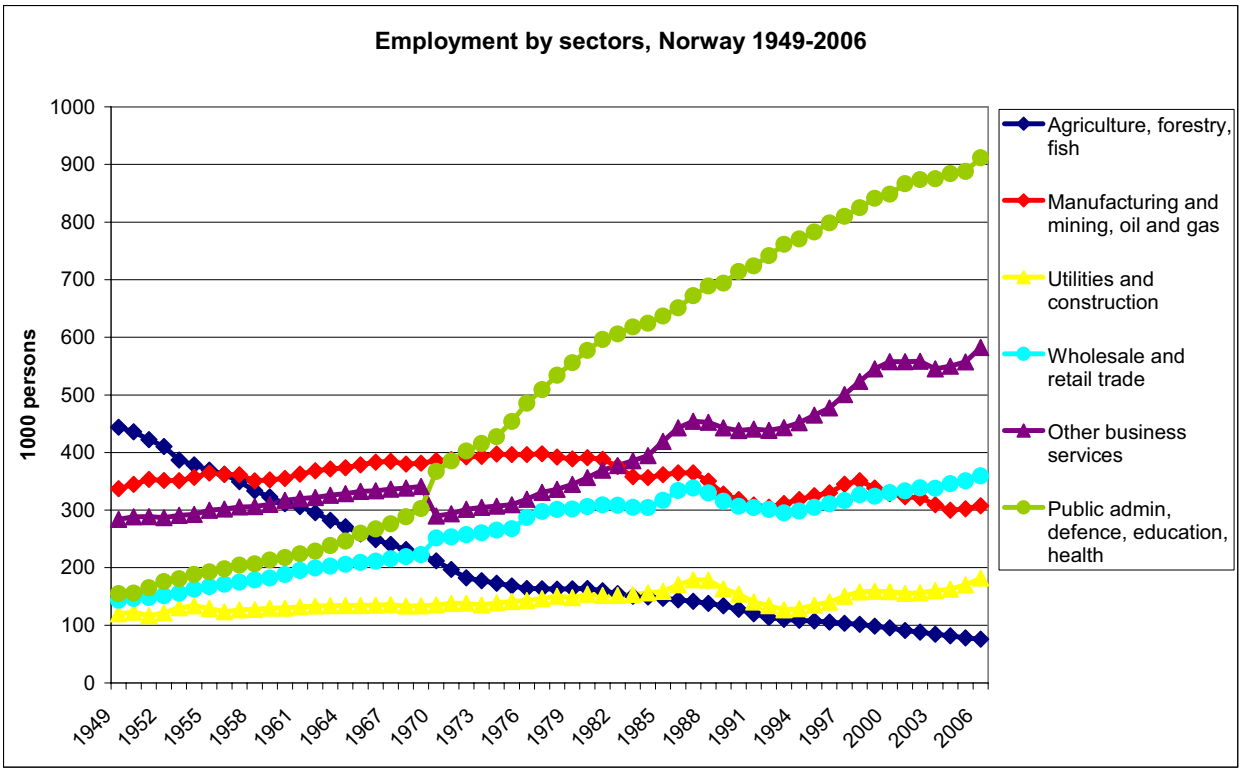

Chart 1: Employment by sector, Norway 1949-2006.

Data source: Statistics Norway, National accounts.

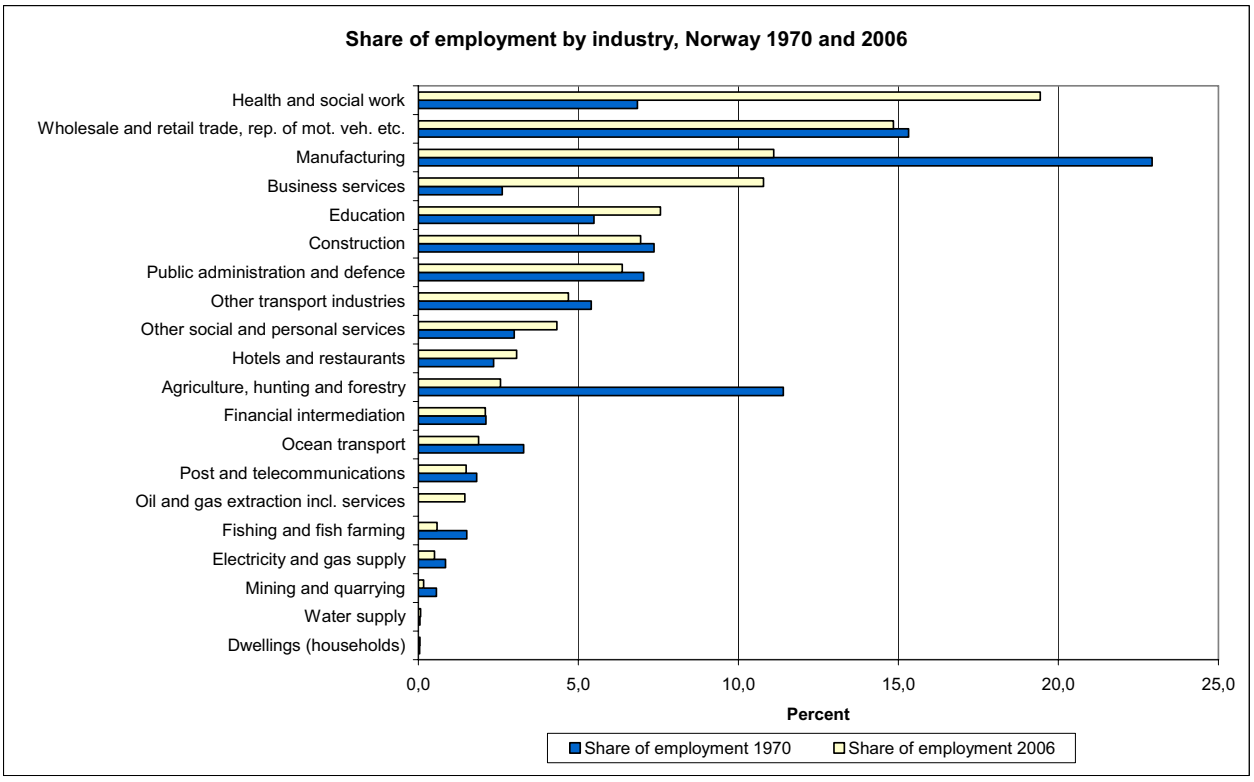

Chart 2: Share of employment by industry, Norway 1970 and 2006.

Data source: Statistics Norway, national accounts.

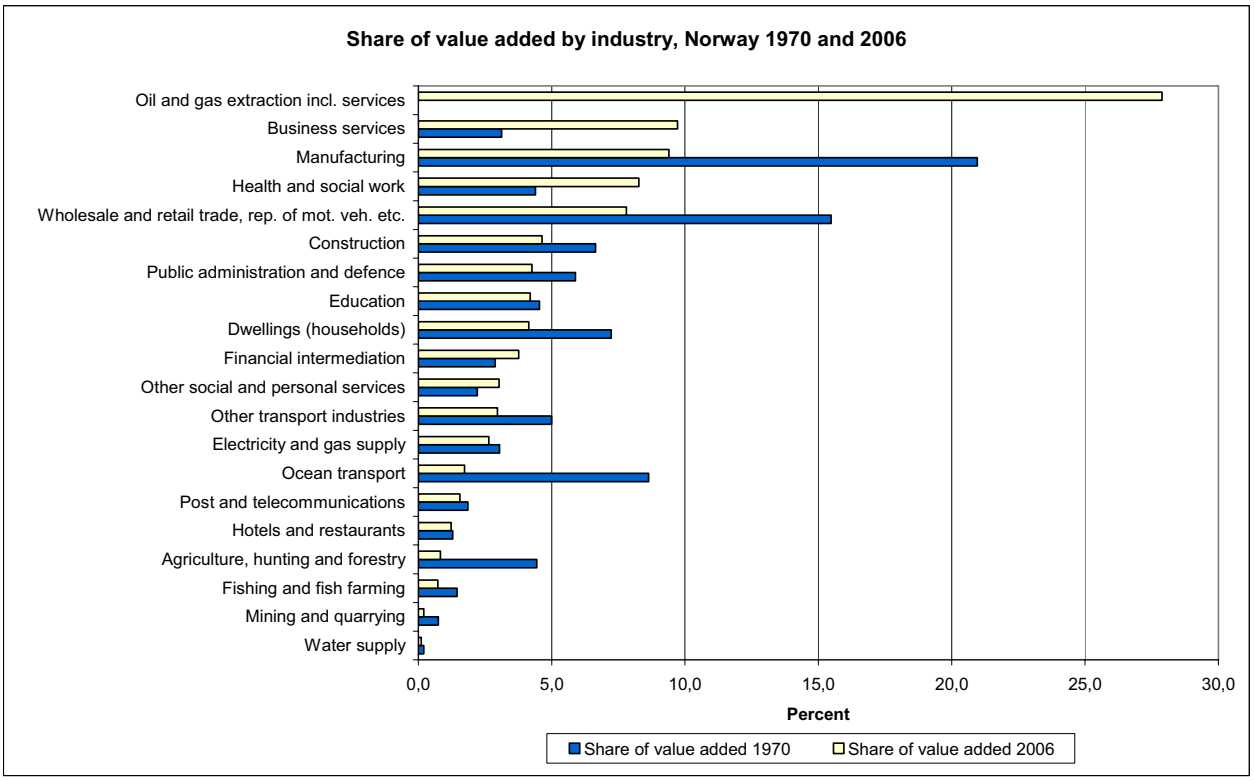

Chart: 3 Share of value added by industry, Norway 1970 and 2006.

Data source: Statistics Norway, national accounts.

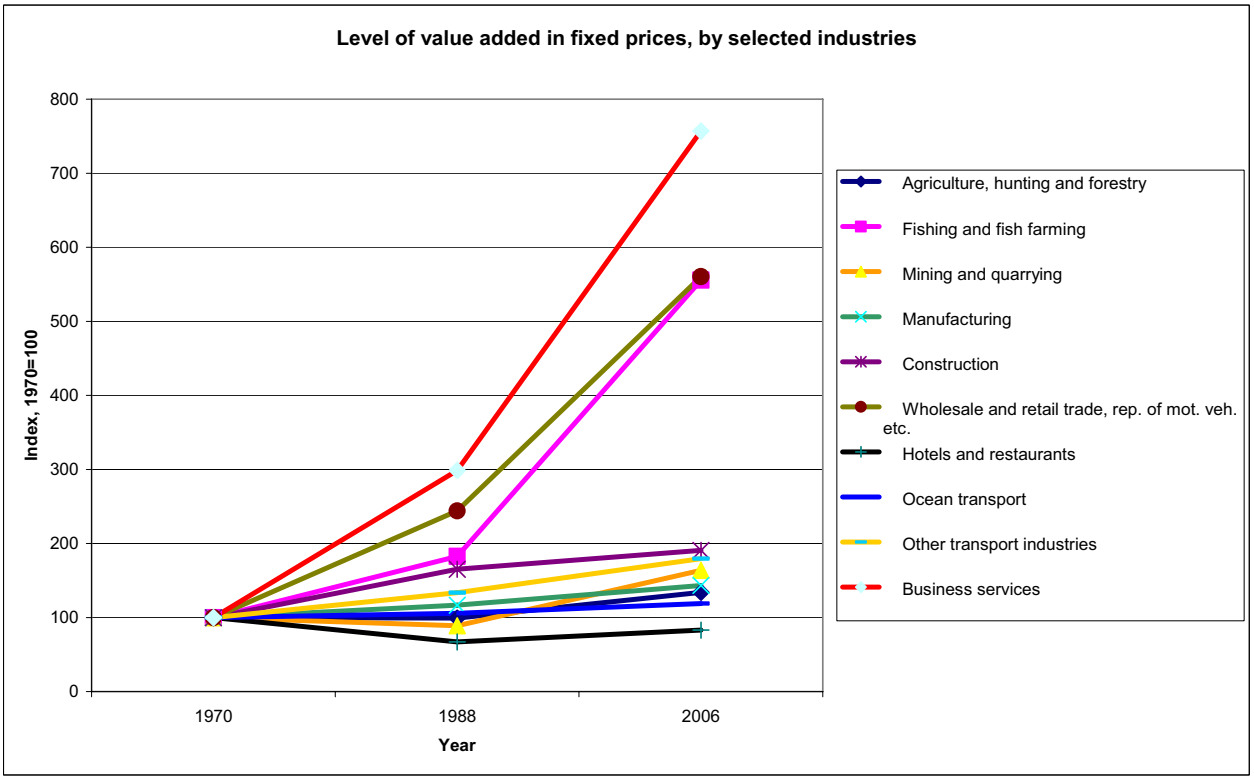

Chart 4: Level of value added in fixed prices. Selected industries. Norway 1970-2006.

Data source: Statistics Norway, national accounts.

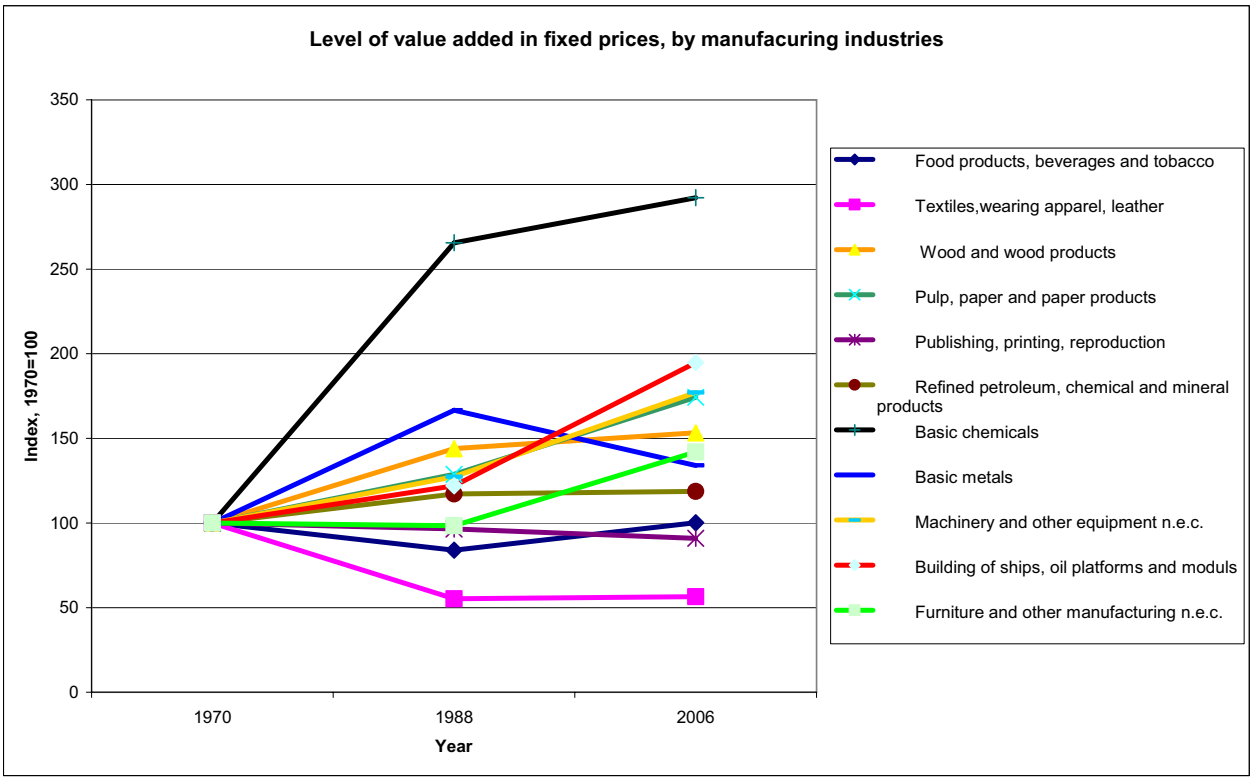

Chart 5: Level of value added in fixed prices. Manufacturing industries. Norway, 1970-2006.

Data source: Statistics Norway, national accounts.

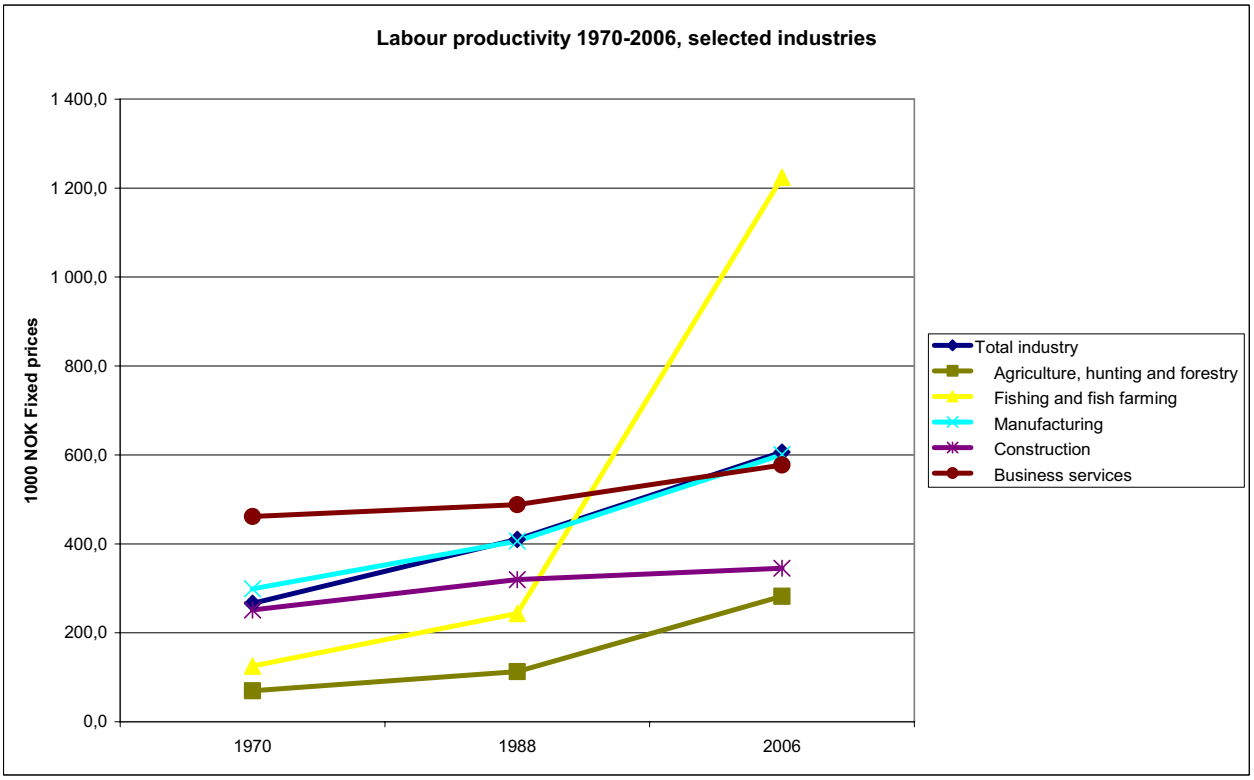

Chart 6: Labour productivity (value added per employee) 1970-2006. Selected industries.

Data source: Statistics Norway, national accounts.

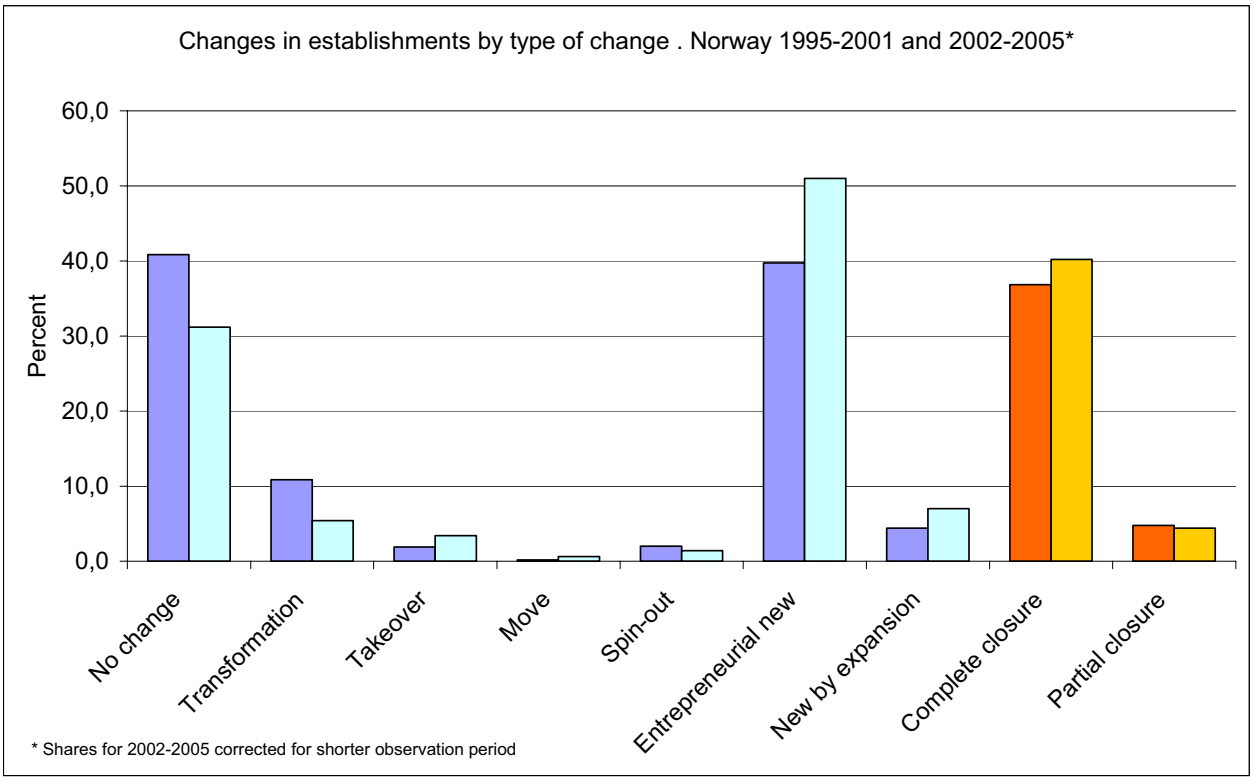

Chart 7: Changes in establishments by type of change. Norway 1995-2001 and 2002-2005. Dark color is 1995-01, light color is 2002-05.

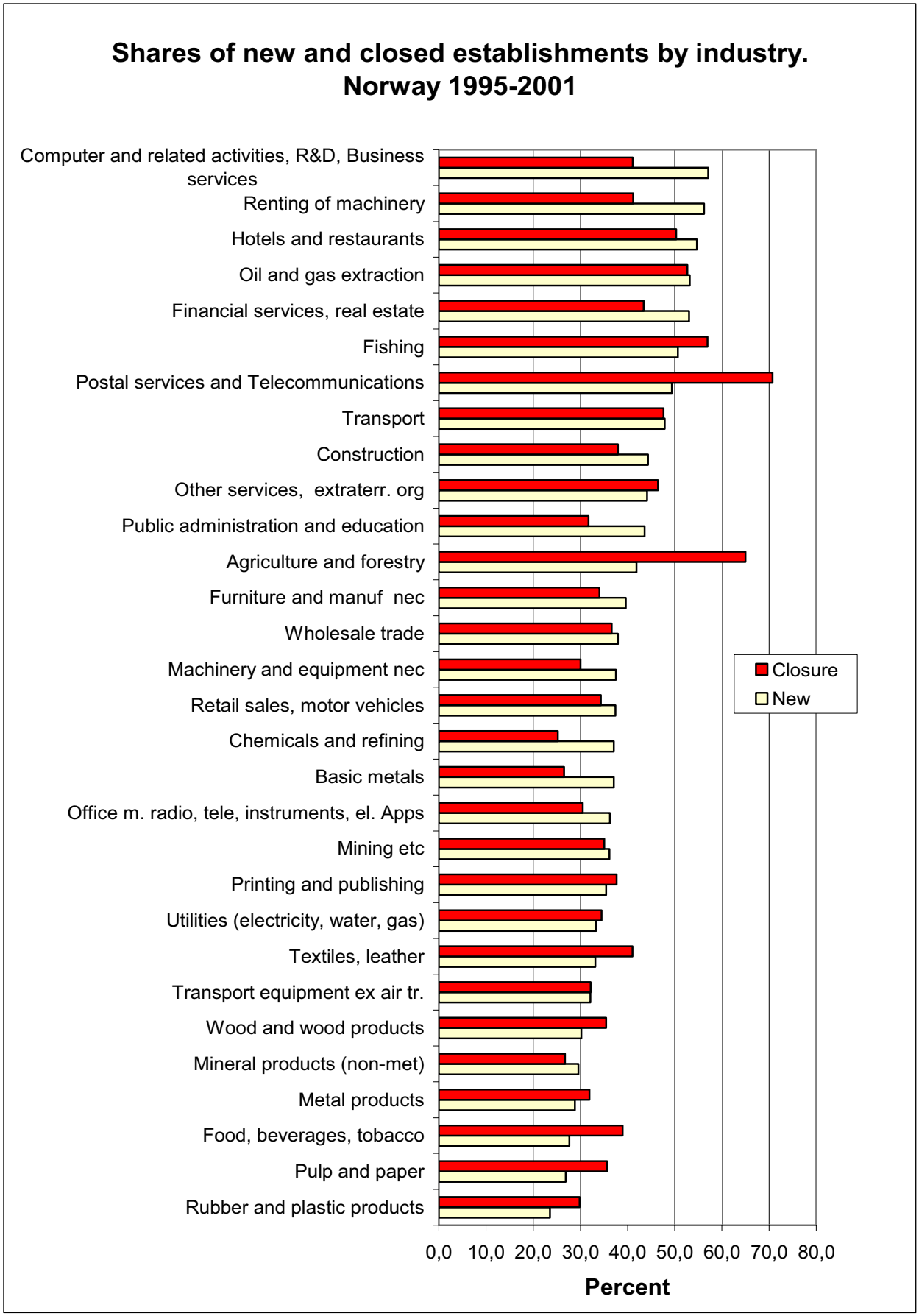

Chart 8: Shares of closed and new establishments by industry. Norway 1995-2001.

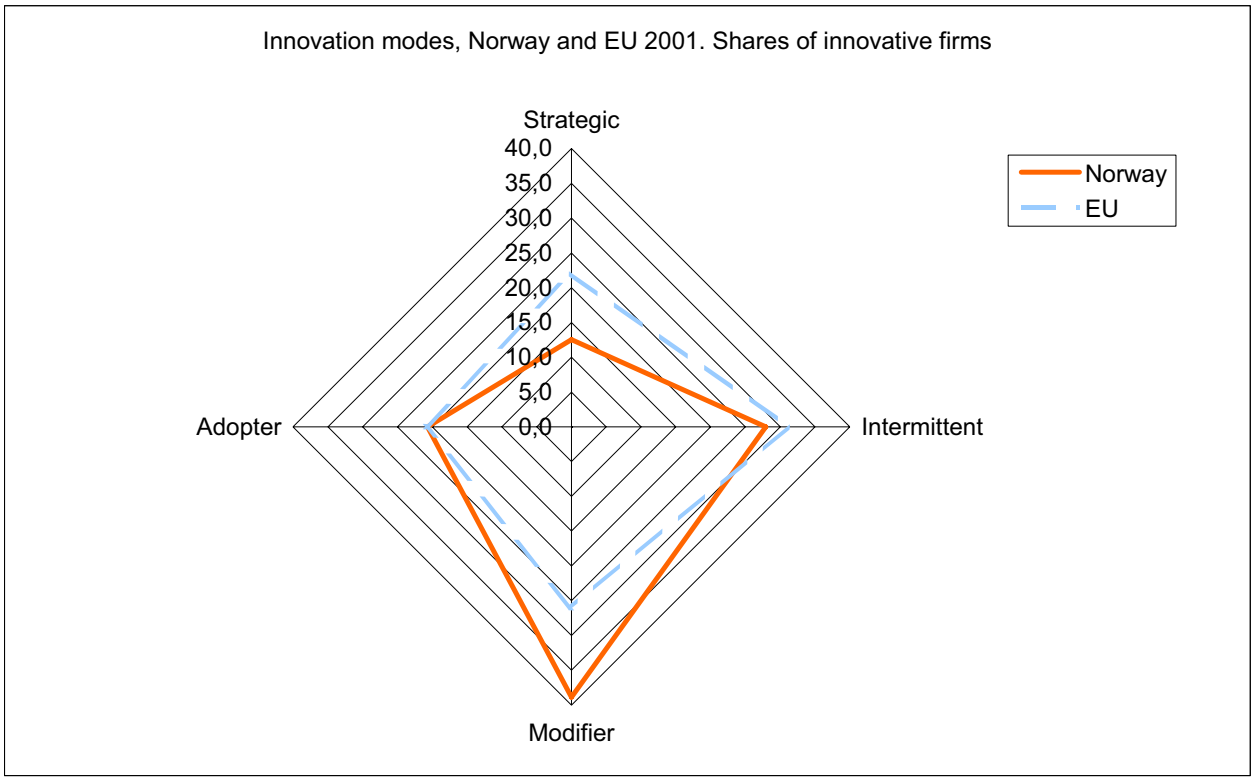

Chart 9: Innovation modes, Norway and EU 2001/2000. Shares of innovative firms, population.

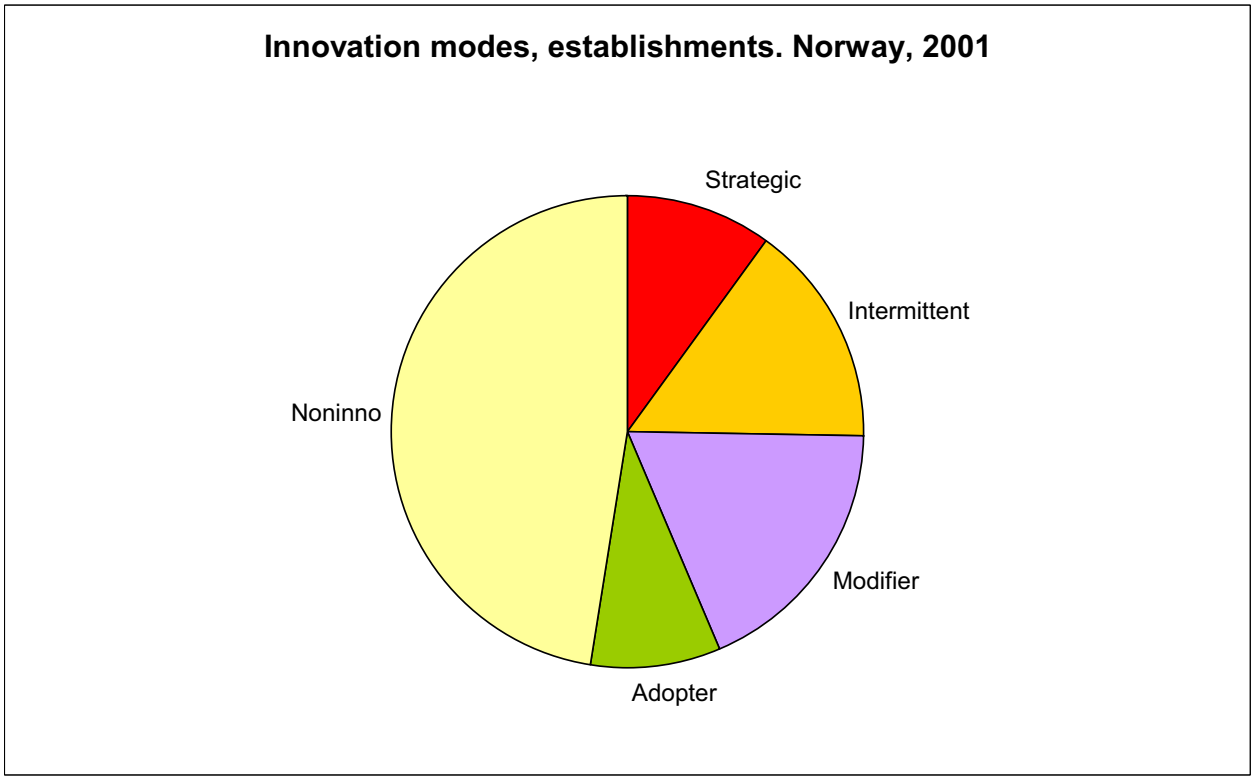

Chart 10: Shares of establishments by innovation modes, Norway 2001. No scaling.

Box 1 Classifying changes in establishments by means of register data

Changes in identification numbers are being used to identify the different types of changes. On the basis of this information 9 different categories of events are distinguished. Classification of changes is carried out by comparing two years. The categories are:

1. No change

An existing establishment continues within the same existing enterprise.

2. Transformation

An existing establishment continues and becomes a new independent enterprise, and the old enterprise is closed down.

3. Takeover

An existing establishment continues within another existing enterprise, and the old enterprise is closed down.

4. Move

An existing establishment continues within another existing enterprise, and the old enterprise survives.

5. Spin-out

An existing establishment continues and becomes a new independent enterprise, and the old enterprise survives.

6. Entrepreneurial new

A new establishment comes into existence as a new independent enterprise.

7. New by expansion

A new establishment comes into existence within an existing enterprise.

8. Complete closure

An establishment is closed down and the enterprise it belongs to is closed down.

9. Partial closure

An establishment is closed down but the enterprise it belongs to survives.

Box 2 Innovation modes

Source: OECD Trend Chart

Strategic/Key creative innovators: These firms have introduced a product or process innovation that they developed at least partly in-house, they perform R&D on a continuous basis, they have introduced at least one product that is new to their market, and they are active in national or international markets. These firms will be the source of many innovative products and processes that are adopted by other firms throughout their domestic economy and internationally.

Intermittent/Second-stream innovators: All of these firms develop innovations at least in part in-house and have introduced new-to-market innovations. But, they are considered less likely to develop innovations that diffuse to others.

Technology modifiers*:* All of these firms have developed an innovation at least in part in-house but none of them perform R&D. They differ from the final group of technology adopters by having some in-house innovative activities. If they are active on national or international markets, they have not introduced a new to market innovation (otherwise they would be classified as a second-stream innovator). If they are active in local and regional markets, they may have introduced a new to market innovation and have slightly modified it for this market. Many firms that are essentially process innovators that innovate through production engineering probably fall within this group.

Technology adopters*:* All of these firms have innovated, but depend on adopting innovations developed by other firms. These firms innovate through diffusion.

Firms that only have ongoing or abandoned innovation activities are also assigned to each of these four innovation modes, using the variables for R&D. In addition, there are complex routines to deal with missing data for each variable.

Table 1: Changes in establishments and enterprises 1999-2000. Sweden, Finland, Denmark, Norway. Percent of number of establishments.

	No Change	Trans-formation	Take-over	Move	Spin-out	Entrepreneurial New	New by expansion	Complete Closure	Partial closure	Total 1999	Total 2000 (=100 %)
Sweden	89,5	0,6	0,4	0,2	0,5	6,9	1,9	5,3	1,7	167 539	170 924
Finland	89,1	0,9	0,5	0,3	0,5	6,7	2,1	6,5	1,7	85 911	86 392
Denmark	89,3	2,3	0,3	0,3	1,0	5,3	1,6	2,8	1,6	97 519	100 055
Norway	88,6	2,1	0,9	0,2	0,4	6,2	1,5	5,4	1,7	103 301	104 053

Note: 1) Percentage shares of closures are calculated according to the number of units year 0. 2) Percentages for surviving or new units are calculated on the basis of the number of units year 1. Source: Nås et al, 2003.

Table 2. Types of changes in establishments 1995-2001 by innovation mode 2001. Share of numbers of establishments.

Type of innovation	No change	Transformation	Takeover	Move	Spin-out	Entrepre-neurial new	New by expan-sion	Com-plete closure (1)	Partial closure	Partly missing info	missing	Total
Strategic	6,5	26,9	0,0	19,0	7,8	7,8	8,4	6,9	24,6	15,3	6,7	10,1
Intermittent	15,4	6,7	0,0	44,3	16,7	16,5	19,3	1,4	12,0	0,0	10,7	15,3
Modifier	21,0	24,0	0,0	0,0	7,6	13,5	20,2	23,6	16,3	49,2	14,2	18,2
Adopter	10,2	1,9	0,0	3,8	2,9	7,4	14,6	0,0	4,5	0,0	8,4	8,8
Noninno	46,9	40,4	100,0	32,9	64,9	54,7	37,5	68,1	42,6	35,6	60,1	47,6
Total	**100,0**	**100,0**	**100,0**	**100,0**	**100,0**	**100,0**	**100,0**	**100,0**	**100,0**	**100,0**	**100,0**	**100,0**
N	4781	104	29	79	510	1396	1308	72	1564	59	431	10333

Data source: Statistics Norway, CIS3 2001 and matched employer-employee register 1995-2001
(1) There is partly overlap in the timing of the series, as the year 2001 is common for both demographic changes and innovation activity. This is why we can observe innovation activity among firms that are closed down.

Table 3: Types of changes in establishments 2002-2005 by innovation mode 2001. Numbers of establishments.

	Innovation mode					
Type of change	A Strategic	B Intermittent	C Modifier	D Adopter	F Noninno	Total
No change	65,0	66,4	71,2	72,7	69,0	69,1
Transformation	9,5	3,6	3,9	2,2	3,7	4,0
Takeover	1,0	9,1	2,1	2,8	3,0	3,6
Move	0,0	0,6	0,2	0,6	0,8	0,6
Spin-out	2,1	0,9	0,4	0,8	1,3	1,1
Entrepreneurial new	0,0	0,0	0,1	0,1	0,1	0,1
New by expansion	2,7	4,3	4,8	5,8	5,8	5,2
Complete closure	6,1	6,1	7,4	6,4	7,0	6,8
Partial closure	9,7	7,5	8,3	7,5	6,1	7,1
Missing	3,9	1,6	1,6	1,0	3,2	2,5
Total	100,0	100,0	100,0	100,0	100,0	100,0
N	671	1463	1883	1067	4905	9989

Data source: Statistics Norway, CIS3 2001 and matched employer-employee register 2002-2005

Statistical appendix

Table A1: Employed persons. Employees and self-employed (1 000) and share of industry employment 1949, 1959, 1969 by industry.

	1000 persons			Share of employed persons		
INDUSTRY	1949	1959	1969	1949	1959	1969
Agriculture and Hunting	363,6	258,1	184,2	24,5	17,1	11,5
Forestry and logging	33,4	25	14,6	2,3	1,7	0,9
Fishing and fish farming	42,4	35,1	24	2,9	2,3	1,5
Whaling	4,3	4,7	0	0,3	0,3	0,0
Oil and gas extraction incl. services	0	0	0	0,0	0,0	0,0
Mining and quarrying	7,8	8,5	8,9	0,5	0,6	0,6
Manufacturing	329,4	343,9	372,6	22,2	22,8	23,2
Food products	46,6	50,5	49,7	3,1	3,3	3,1
Beverages and tobacco	6,9	6,2	6,4	0,5	0,4	0,4
Textiles, wearing apparel, leather	60,8	48,1	37,5	4,1	3,2	2,3
Wood and wood products	33,7	27,8	27,1	2,3	1,8	1,7
Pulp, paper and paper products	20,3	24,8	22,7	1,4	1,6	1,4
Publishing, printing, reproduction	21,2	26,3	31,3	1,4	1,7	2,0
Refined petroleum, chemical and mineral products	22,5	24,7	31,9	1,5	1,6	2,0
Basic chemicals	8,2	12,1	10,6	0,6	0,8	0,7
Basic metals	12,6	17,9	22,5	0,8	1,2	1,4
Machinery and other equipment n.e.c.	57,8	66,4	85,3	3,9	4,4	5,3
Building of ships, oil platforms and modules	22,7	24,5	31,5	1,5	1,6	2,0
Furniture and other manufacturing n.e.c.	16,1	14,6	16,1	1,1	1,0	1,0
Electricity and gas supply	11,3	12,4	13,8	0,8	0,8	0,9
Water supply	0,8	0,8	0,8	0,1	0,1	0,0
Construction	107,7	116,7	119,3	7,3	7,7	7,4
Wholesale and retail trade	143,5	181,9	222,7	9,7	12,0	13,9
Repair of motor vehicles and goods	12,2	12,8	17,4	0,8	0,8	1,1
Hotels and restaurants	23,5	31,8	35,3	1,6	2,1	2,2
Transport via pipelines	0	0	0	0,0	0,0	0,0
Ocean transport	43,1	66,2	61	2,9	4,4	3,8
Inland water transport	7,8	9,9	9,6	0,5	0,7	0,6
Services for inland water transport	5,9	6	7,5	0,4	0,4	0,5
Rail transport	26	23,8	17,9	1,8	1,6	1,1
Other land transport	28,3	28,9	33,5	1,9	1,9	2,1
Air transport	1,2	1,6	5,1	0,1	0,1	0,3
Supporting transport activities	5,2	6,5	9,8	0,4	0,4	0,6
Post and telecommunications	22,9	25,5	29	1,5	1,7	1,8
Financial intermediation	9,4	12,2	21,1	0,6	0,8	1,3
Insurance and pension funding	7,1	7,7	9,9	0,5	0,5	0,6
Dwellings (households)	0,5	0,6	0,6	0,0	0,0	0,0
Business services	19,2	23,9	40,1	1,3	1,6	2,5
Public administration	37,6	47,2	56,7	2,5	3,1	3,5
Public defense	35,3	52,1	54	2,4	3,4	3,4
Education	31,8	50,1	85,4	2,1	3,3	5,3
Health and social work	50	63,8	106,4	3,4	4,2	6,6
Domestic services	49,4	26,6	9,3	3,3	1,8	0,6
Other social and personal services	22,4	26,2	33,8	1,5	1,7	2,1
Total industry	1483,2	1510,8	1604,2	100,0	100,0	100,0

Source: Statistics Norway, national accounts, historical data.

Table A2: Share of industry employment 1970, 1988, 2006 by industry.

	Employment		
	1970	**1988**	**2006**
Total industry	100,0	100,0	100,0
Agriculture, hunting and forestry	11,4	5,4	2,6
Fishing and fish farming	1,5	1,1	0,6
Oil and gas extraction incl. services	0,0	1,0	1,5
Oil and gas extraction	0,0	0,8	0,8
Service activities incidental to oil and gas	0,0	0,2	0,6
Mining and quarrying	0,6	0,3	0,2
Manufacturing	22,9	15,1	11,1
Food products, beverages and tobacco	3,5	2,6	2,0
Textiles, wearing apparel, leather	2,3	0,6	0,2
Wood and wood products	1,7	1,1	0,6
Pulp, paper and paper products	1,4	0,6	0,3
Publishing, printing, reproduction	1,7	1,6	1,2
Refined petroleum, chem.. and mineral products	2,0	1,4	0,9
Basic chemicals	0,6	0,4	0,3
Basic metals	1,4	1,0	0,5
Machinery and other equipment n.e.c.	5,5	3,9	3,0
Building of ships, oil platforms and modules	1,9	1,2	1,5
Furniture and other manufacturing n.e.c.	1,1	0,7	0,5
Electricity and gas supply	0,9	0,9	0,5
Water supply	0,0	0,0	0,1
Construction	7,4	7,4	6,9
Wholesale and retail trade, rep. of mot. veh. etc.	15,3	15,4	14,8
Hotels and restaurants	2,4	3,1	3,1
Transport via pipelines	0,0	0,0	0,0
Ocean transport	3,3	1,4	1,9
Other transport industries	5,4	5,2	4,7
Post and telecommunications	1,8	2,5	1,5
Financial intermediation	2,1	3,2	2,1
Dwellings (households)	0,0	0,0	0,1
Business services	2,6	5,7	10,8
Public administration and defense	7,0	7,6	6,4
Education	5,5	6,9	7,6
Health and social work	6,8	13,6	19,4
Other social and personal services	3,0	4,1	4,3

Source: Statistics Norway, National Accounts

Table A3: Value added at constant prices, by industry. Norway 1970-2006

Value added, Constant prices (mill. NOK)	1970	1988	2006
GROSS DOMESTIC PRODUKT	508 117	1 000 078	1 699 998
Total industry	437 076	877 405	1 466 061
Agriculture, hunting and forestry	13 037	12 950	17 496
Fishing and fish farming	3 106	5 674	17 263
Oil and gas extraction incl. services	0	121 425	321 217
Oil and gas extraction	0	114 429	309 618
Service activities incidental to oil and gas	0	8 686	7 661
Mining and quarrying	1 943	1 728	3 185
Manufacturing	112 461	131 263	161 264
Food products, beverages and tobacco	24 374	20 454	24 397
Textiles, wearing apparel, leather	4 690	2 591	2 647
Wood and wood products	5 021	7 229	7 695
Pulp, paper and paper products	3 150	4 054	5 489
Publishing, printing, reproduction	17 689	17 071	16 093
Refined petroleum, chem.. and mineral products	14 187	16 635	16 839
Basic chemicals	2 069	5 495	6 046
Basic metals	11 589	19 307	15 524
Machinery and other equipment n.e.c.	23 316	29 687	41 282
Building of ships, oil platforms and modules	9 177	11 194	17 869
Furniture and other manufacturing n.e.c.	4 752	4 678	6 750
Electricity and gas supply	8 770	19 165	23 009
Water supply	1 198	2 221	1 708
Construction	30 408	50 264	57 995
Wholesale and retail trade, rep. of mot. veh. etc.	27 430	66 957	153 753
Hotels and restaurants	22 935	15 365	19 030
Transport via pipelines	0	7 530	26 940
Ocean transport	14 171	14 982	16 868
Other transport industries	27 406	36 605	49 192
Post and telecommunications	3 137	7 738	33 820
Financial intermediation	28 962	33 711	64 468
Dwellings (households)	31 098	52 678	63 255
Business services	19 893	59 417	150 593
Public administration and defense	33 463	53 183	62 932
Education	28 314	44 294	60 656
Health and social work	33 794	75 521	117 977
Other social and personal services	16 605	31 529	45 620

Source: Statistics Norway, National Accounts

Table A4: Labour productivity (value added per employee) 1970, 1988, 2006, by industry. Fixed prices, 1000 NOK.

	1970	1988	2006
Total industry	266,3	410,3	606,1
Agriculture, hunting and forestry	69,6	112,7	282,2
Fishing and fish farming	125,2	243,5	1 224,3
Oil and gas extraction incl. services		5 865,9	9 125,5
Oil and gas extraction		6 977,4	15 403,9
Service activities incidental to oil and gas		2 020,0	507,4
Mining and quarrying	208,9	261,8	796,3
Manufacturing	298,9	406,4	600,6
Food products, beverages and tobacco	429,9	362,0	509,3
Textiles, wearing apparel, leather	126,4	204,0	481,3
Wood and wood products	181,3	296,3	496,5
Pulp, paper and paper products	137,6	332,3	741,8
Publishing, printing, reproduction	629,5	502,1	566,7
Refined petroleum, chem. and mineral products	429,9	558,2	765,4
Basic chemicals	206,9	578,4	755,8
Basic metals	506,1	937,2	1 326,8
Machinery and other equipment n.e.c.	258,5	359,0	560,1
Building of ships, oil platforms and modules	299,9	425,6	496,4
Furniture and other manufacturing n.e.c.	274,7	322,6	544,4
Electricity and gas supply	626,4	944,1	1 870,7
Water supply	1 497,5	2 776,3	1 004,7
Construction	251,5	319,3	345,2
Wholesale and retail trade, rep. of mot. veh. etc.	109,1	203,0	428,2
Hotels and restaurants	594,2	230,0	256,1
Transport via pipelines		25 100,0	53 880,0
Ocean transport	262,4	516,6	369,9
Other transport industries	309,0	328,9	433,8
Post and telecommunications	104,6	142,2	936,8
Financial intermediation	837,1	494,3	1 276,6
Dwellings (households)	51 830,0	52 678,0	48 657,7
Business services	461,6	488,2	577,2
Public administration and defense	289,7	326,3	408,6
Education	314,3	301,9	331,6
Health and social work	300,9	259,3	251,0
Other social and personal services	338,2	358,7	435,7

Table A5: Employees per establishment 1988, 1994, 1995, 2001 by industry

		Average size			
		1988	1994	1995	2001
10,12-14	Mining etc	16,1	14,1	12,7	10,3
11	Oil and gas extraction	170,5	185,8	147,6	112,3
15-16	Food, beverages, tobacco	24,7	26,0	25,9	28,4
17-19	Textiles, leather	18,4	15,5	14,2	11,7
20	Wood and wood products	15,4	13,2	12,6	13,3
21	Pulp and paper	89,4	78,3	69,0	75,3
22	Printing and publishing	13,4	12,0	13,0	13,7
23-24	Chemicals and refining	70,4	76,2	70,9	64,3
25	Rubber and plastic products	26,1	18,7	18,1	17,3
26	Mineral products (non-met)	20,8	15,9	16,8	15,1
27	Basic metals	166,0	121,2	105,4	80,2
28	Metal products	15,5	13,6	13,7	15,3
29	Machinery and equipment nec	21,9	18,3	18,3	16,9
30-33	Office m. radio, tele, instruments, el. Apps	30,7	23,8	24,7	22,6
34-35	Transport equipment ex air tr.	40,9	46,3	51,2	46,4
36-37	Furniture and manuf nec	16,2	15,8	15,7	13,9
40-41	Utilities (electricity, water, gas)	39,9	31,1	23,3	20,1
45	Construction	9,8	7,9	7,9	9,4
50+52	Retail sales, motor vehicles	6,7	6,4	6,2	6,8
51	Wholesale trade	9,9	8,8	8,7	8,7
55	Hotels and restaurants	12,9	10,8	9,9	9,6
60-63	Transport	9,3	9,9	9,3	10,6
64	Postal services and Telecom	51,8	73,3	18,2	28,5
65-67+70	Financial services, real estate	18,4	16,5	11,0	9,4
71	Renting of machinery	8,3	7,7	6,6	5,7
72-74	Computer activities, R&D, Business services	10,5	9,9	8,8	9,6
75-85	Public administration and education	33,4	31,0	24,2	22,4
90-99	Other services, extraterr. org	7,4	7,0	5,0	6,0
	Total excl primary	13,9	13,8	12,3	12,6
	N				
15-37	Total industry	23,9	22,2	22,2	21,9
50-99	Total services	12,6	13,1	11,4	11,8

Source: Statistics Norway, matched employer-employee register.

Table A6: Concentration ratio for establishments 1988, 1994, 1995, 2001 by industry. Herfindahl index.

aggnace2		H 1988	H 1994	H 1995	H 2001	Diff 88-94	Diff 95-01	Diff 88-94
10,12-14	Mining etc	0,040	0,035	0,025	0,017	-0,005	-0,008	-0,023
11	Oil and gas extraction	0,079	0,052	0,054	0,037	-0,027	-0,017	-0,041
15-16	Food, beverages, tobacco	0,003	0,003	0,003	0,003	0,000	0,000	0,000
17-19	Textiles, leather	0,007	0,008	0,007	0,009	0,001	0,002	0,002
20	Wood and wood products	0,006	0,005	0,005	0,005	-0,001	0,001	0,000
21	Pulp and paper	0,033	0,037	0,033	0,037	0,004	0,004	0,005
22	Printing and publishing	0,009	0,005	0,007	0,008	-0,004	0,001	-0,001
23-24	Chemicals and refining	0,025	0,025	0,022	0,026	0,001	0,003	0,001
25	Rubber and plastic products	0,027	0,014	0,010	0,010	-0,013	-0,001	-0,017
26	Mineral products (non-met)	0,010	0,011	0,011	0,008	0,001	-0,002	-0,002
27	Basic metals	0,051	0,047	0,040	0,030	-0,004	-0,010	-0,022
28	Metal products	0,004	0,005	0,004	0,003	0,001	-0,001	-0,001
29	Machinery and equipment nec	0,016	0,014	0,009	0,007	-0,001	-0,002	-0,008
30-33	Office m. radio, tele, instruments, el. Apps	0,022	0,011	0,012	0,009	-0,011	-0,003	-0,013
34-35	Transport equipment ex air tr.	0,012	0,013	0,010	0,012	0,000	0,002	0,000
36-37	Furniture and manuf nec	0,008	0,008	0,008	0,008	0,000	0,000	-0,001
40-41	Utilities (electricity, water, gas)	0,021	0,007	0,006	0,007	-0,014	0,001	-0,015
45	Construction	0,001	0,002	0,001	0,001	0,001	0,000	-0,001
50+52	Retail sales, motor vehicles	0,000	0,000	0,000	0,000	0,000	0,000	0,000
51	Wholesale trade	0,001	0,001	0,001	0,001	0,000	0,000	0,000
55	Hotels and restaurants	0,001	0,001	0,001	0,001	0,000	0,000	-0,001
60-63	Transport	0,005	0,005	0,002	0,003	0,000	0,000	-0,002
64	Postal services and Telecommunications	0,416	0,011	0,005	0,007	-0,405	0,001	-0,409
65-67+70	Financial services, real estate	0,006	0,007	0,006	0,006	0,001	0,000	0,000
71	Renting of machinery	0,029	0,021	0,016	0,004	-0,009	-0,011	-0,025
72-74	Computer and related activities, R&D, Business	0,002	0,002	0,002	0,001	0,000	-0,001	-0,001
75-85	Public administration and education	0,001	0,003	0,001	0,001	0,001	0,000	-0,001
90-99	Other services, extraterr. org	0,006	0,004	0,002	0,002	-0,002	-0,001	-0,004

H<0,1: “Unconcentrated”
0,1<H<0,18: “Moderate concentration”
0,18<H: “Highly concentrated”

Source: Statistics Norway, matched employer-employee register.

Table A7: Changes in establishments by type of change, 1988-94 and 1995-2001. Numbers of establishments and percent.

	Number of establishments							
	1988 chg8894	1994 chg8894	1995 chg9501	2001 chg9501	1988 chg8894	1994 chg8894	1995 chg9501	2001 chg9501
Type of change	N	N	N	N	Percent	Percent	Percent	Percent
No change	48 262	48 262	65 298	65 298	46,9	45,4	42,4	40,8
Transformation	10 135	10 135	17 340	17 340	9,9	9,5	11,3	10,8
Takeover	853	853	3 015	3 015	0,8	0,8	2,0	1,9
Move	89	89	275	275	0,1	0,1	0,2	0,2
Spin-out	1 712	1 712	3 167	3 167	1,7	1,6	2,1	2,0
Entrepreneurial new		36 388		63 553		34,2		39,7
New by expansion		8 506		7 039		8,0		4,4
Complete closure	30 453		56 717		29,6		36,8	
Partial closure	10 484		7 315		10,2		4,7	
Ent info missing, No change est	302	302	172	172	0,3	0,3	0,1	0,1
Ent info missing, New est		47		37		0,0		0,0
Ent info missing, Closed est	536		703		0,5		0,5	
Total	102 826	106 294	154 002	159 896	100,0	100,0	100,0	100,0

Source: Statistics Norway, matched employer-employee register.

Table A8: Changes in establishments by type of change, 1988-94 and 1995-2001. Numbers of employees and percent.

	Number of employees							
	chg8894 1988	**chg8894 1994**	**chg9501 1995**	**chg9501 2001**	**chg8894 1988**	**chg8894 1994**	**chg9501 1995**	**chg9501 2001**
Type of change	**N**	**N**	**N**	**N**	**Percent**	**Percent**	**Percent**	**Percent**
No change	757 762	732 316	755 758	798 807	43,1	42,6	42,2	41,0
Transformation	261 154	241 930	387 796	400 375	14,9	14,1	21,7	20,5
Takeover	39 464	31 717	56 073	55 328	2,2	1,8	3,1	2,8
Move	3 522	3 493	11 895	10 895	0,2	0,2	0,7	0,6
Spin-out	74 441	44 462	126 064	103 710	4,2	2,6	7,0	5,3
Entrepreneurial new		364 353		459 572		21,2		23,6
New by expansion		85 105		87 145		5,0		4,5
Complete closure	214 330		310 991		12,2		17,4	
Partial closure	100 645		100 095		5,7		5,6	
Ent info missing, No change est	293 520	213 802	37 757	34 289	16,7	12,4	2,1	1,8
Ent info missing, New est		841		131		0,0		0,0
Ent info missing, Closed est	11 357		2 491		0,6		0,1	
Total	1 756 195	1 718 019	1 788 920	1 950 252	100,0	100,0	100,0	100,0

Table A9: Changes in establishments by type of change, 2002-2005. Numbers of establishments and percent.

	2002 N	2005 N	2002 Percent	2005 Percent
No change	190347	190347	71,9	65,6
Transformation	7755	7755	2,9	2,7
Takeover	4971	4971	1,9	1,7
Move	798	798	0,3	0,3
Spin-out	1892	1892	0,7	0,7
Entrepreneurial new		73968		25,5
New by expansion		10227		3,5
Complete closure	53246		20,1	
Partial closure	5713		2,2	
Ent info miss no change est	94	94	0,0	0,0
Ent info missing, new est	81	81	0,0	0,0
Ent info missing, closed est	214	214	0,1	0,1
Total	264722	289958	100,0	100,0

Table A10: Changes in establishments by type of change and industry, 1995-2001. Percent.

Industry	No change	Transfor-mation	Takeover	Move	Spin-out	Entrepre-neurial new	New by expansion	**Complete closure**	**Partial closure**	Missing info	Total 2001
Agriculture and forestry	49,6	7,6	0,7	0,0	0,2	40,6	1,3	**62,6**	**2,4**	0,0	100,0
Fishing	38,5	8,1	2,8	0,0	0,0	46,7	4,0	**55,5**	**1,4**	0,9	100,0
Mining etc	51,9	6,3	0,5	1,6	3,5	30,2	6,0	**29,3**	**5,7**	0,3	100,0
Oil and gas extraction	38,4	5,9	0,8	0,8	0,4	44,3	8,9	**39,9**	**12,8**	0,4	100,0
Food, beverages, tobacco	54,2	13,1	3,0	0,3	1,8	23,9	3,7	**31,2**	**7,8**	0,1	100,0
Textiles, leather	55,9	8,8	1,1	0,0	1,1	31,3	1,9	**37,7**	**3,4**	0,2	100,0
Wood and wood products	58,7	9,2	0,6	0,0	1,1	28,9	1,4	**30,8**	**4,7**	0,2	100,0
Pulp and paper	55,5	4,2	5,9	0,0	7,6	21,0	5,9	**19,6**	**16,1**	0,0	100,0
Printing and publishing	58,2	4,9	0,6	0,1	0,8	32,4	3,1	**33,4**	**4,3**	0,0	100,0
Chemicals and refining	51,7	6,9	1,2	1,5	1,5	27,0	10,0	**15,3**	**9,9**	0,0	100,0
Rubber and plastic products	63,4	7,6	1,2	1,5	2,9	20,9	2,6	**22,8**	**7,0**	0,0	100,0
Mineral products (non-met)	49,7	7,7	4,9	4,2	3,9	24,2	5,4	**24,2**	**2,5**	0,0	100,0
Basic metals	47,6	10,6	0,6	1,8	2,4	33,5	3,5	**18,2**	**8,3**	0,0	100,0
Metal products	59,9	9,1	1,3	0,2	0,7	27,0	1,8	**30,6**	**1,3**	0,0	100,0
Machinery and equipment nec	53,9	6,7	0,9	0,1	0,8	34,3	3,2	**26,2**	**3,8**	0,0	100,0
Office m. radio, tele, instruments, el. Apps	49,5	11,4	1,4	0,0	1,5	32,6	3,7	**26,4**	**4,1**	0,0	100,0
Transport equipment ex air tr.	54,6	11,6	0,9	0,1	0,7	28,7	3,4	**26,6**	**5,6**	0,0	100,0
Furniture and manuf nec	48,3	7,6	2,3	1,5	0,6	35,2	4,4	**30,8**	**3,2**	0,1	100,0
Utilities (electricity, water, gas)	31,0	22,7	8,8	0,0	4,1	28,5	4,8	**26,3**	**8,2**	0,1	100,0
Construction	45,6	8,4	0,5	0,0	0,8	42,9	1,4	**35,8**	**2,1**	0,4	100,0
Retail sales, motor vehicles	45,5	12,4	3,1	0,3	1,2	29,2	8,2	**30,4**	**4,0**	0,0	100,0
Wholesale trade	54,1	5,2	1,6	0,1	1,0	34,4	3,6	**32,4**	**4,3**	0,0	100,0
Hotels and restaurants	30,0	12,3	1,8	0,2	1,1	49,0	5,6	**46,6**	**3,7**	0,1	100,0
Transport	43,3	4,8	0,6	0,2	3,2	45,2	2,7	**42,5**	**5,2**	0,2	100,0
Postal services and Telecommunications	24,9	8,3	15,9	0,9	0,6	31,1	18,3	**32,7**	**38,0**	12,2	100,0
Financial services, real estate	41,8	2,9	1,9	0,1	0,2	44,3	8,7	**36,0**	**7,4**	0,0	100,0
Renting of machinery	34,7	6,3	2,6	0,0	0,2	46,8	9,4	**37,7**	**3,5**	0,0	100,0
Computer and related activities, R&D, Business services	36,6	4,3	0,9	0,1	0,9	53,9	3,2	**38,8**	**2,3**	0,2	100,0
Public administration and education	25,6	22,6	2,5	0,0	5,4	40,4	3,2	**26,4**	**5,3**	0,4	100,0
Other services, extraterr. Org	43,7	9,6	0,6	0,2	1,6	40,8	3,3	**42,9**	**3,6**	0,2	100,0
Missing info	29,8	0,5	0,0	0,0	0,0	60,4	2,4	**67,5**	**6,0**	75,0	100,0
Total	40,8	10,8	1,9	0,2	2,0	39,7	4,4	**36,8**	**4,7**	0,6	100,0

Table A11: Innovation modes 2001, enterprises, by industry. Population figures

	Innovation modes						
Industry	Strategic	Intermittent	Modifier	Adopter	Noninnovators	Total	N
Fish farming	5,2	12,3	10,4	11,4	60,7	100,0	105
Mining and quarrying	1,3	7,4	16,1	3,8	71,4	100,0	78
Oil and gas	7,3	15,2	19,8	8,9	48,8	100,0	84
Food products	2,6	6,5	17,2	10,4	63,4	100,0	742
Textiles, leather and wood products	5,8	10,7	13,9	3,7	65,9	100,0	462
Pulp and paper, chemicals	17,9	19,6	12,3	11,5	38,8	100,0	140
Printing and publishing	6,1	2,0	9,2	5,4	77,3	100,0	499
Rubber and plastics	7,3	15,6	18,9	10,8	47,3	100,0	268
Basic metals	5,2	21,6	21,6	1,3	50,2	100,0	78
Metal products and machinery	4,9	16,1	13,5	5,5	59,9	100,0	831
Electrical and optical equipment	25,3	16,4	9,3	7,8	41,1	100,0	249
Transport equipment	4,9	16,8	6,3	4,0	68,0	100,0	362
Furniture and recycling	6,8	15,1	17,3	7,8	53,0	100,0	262
Electricity, gas, water and construction	0,2	3,4	9,2	5,2	82,0	100,0	2779
Wholesale trade	3,4	7,0	15,9	8,9	64,8	100,0	2093
Transport, storage and communication	1,6	4,4	5,3	3,0	85,7	100,0	1375
Financial services	0,9	6,3	18,4	18,3	56,1	100,0	328
Business services	8,4	20,1	16,3	5,9	49,3	100,0	1178
Total	4,0	8,9	12,4	6,6	68,0	100,0	11913

Data source: Statistics Norway, CIS 3.